

Application No. 10/056,845
Amendment dated April 27, 2005
Reply to Office Action dated February 9, 2005

AMENDMENT TO SPECIFICATION

Please replace two consecutive paragraphs, the first beginning page 4 and the second ending on 5, with the following two paragraphs

The catalyst composite can be created by mixing metal-oxide precursor solutions, either neat or in a compatible solvent, and applying the solution to a substrate. In one embodiment, the metal-oxide precursor solution is tin, cerium, zirconium-(II) ethyl hexanoate and the compatible solvent is ~~metal methyl~~ ethyl ketone [MEK]. In this embodiment the mass ratio for the tin: cerium: zirconium is 1.0: 0.5: 0.5. For automotive applications, the substrate can, for example, be a honeycomb-structured ceramic or metal and the coating application can be performed by a single dip-deaerate-dip sequence. Following the application, the catalyst coating can be thermally treated through various programs to eliminate solvent and convert the mixed-metal precursor solution to a mixed-metal oxide coating. In at least one embodiment, promoter metal species, selected from the group consisting of oxides of the metals of the transition series of the periodic table of elements (e.g., iron, cobalt, nickel) are then applied by dipping in aqueous metal nitrate solutions followed by an additional thermal treatment. Noble metal species, selected from the group consisting of platinum, palladium, gold, silver, and rhodium, are then applied from aqueous solutions directly to the coating channels quantitatively. This can be done by using a Pasteur pipette followed by a final thermal treatment. In at least one embodiment, the noble metal comprises from about 1 to about 50 weight percent, based on the total weight of the catalyst and the metal oxides comprise from about 50 to about 99 weight percent, based on the total weight of the catalyst. The promoter may be present in an amount sufficient to provide from about 1 to about 12 atom percent of promoter metal to tin metal.

In the conventional mode of catalyst preparation, multiple layers of the inactive support (e.g., alumina) are applied to a substrate material (e.g., cordierite, silica gel) by successive wash coating of a slurry of particles dispersed in a solvent (e.g., alcohol). The mechanism for adherence is simple absorption of material, relying heavily on the predilection of smaller particles to penetrate and absorb to the porous regions of the substrate to form an anchor for

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subsequent layers. In contrast, the mixed metal (e.g., Sn, Ce, Zr) precursor solutions can readily penetrate the porous cracks and fissures in the substrate material, chemically bonding to the surface through a condensation mechanism with surface hydroxyl groups. The result of this approach is significant improvements in catalyst adherence, catalytic efficiency/surface area, and durability (temperature stability). In at least one embodiment, the reducible metal oxide active layer is produced by applying a homogeneous solution of tin ethylhexanoate (SnEH), cerium (II) ethylhexanoate (CeEH), and zirconium (II) ~~ethylhexanoate~~ ethylhexanoate (ZrEH) to the substrate and oxidizing the absorbed and adsorbed SnEH/CeEH/ZrEH to a tin oxide (SnO₂)/ceria/zirconia composite by heating to high temperature (550 – 800 centigrade). This produces catalyst materials that are stable under high-temperature operation in reducing environments.